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Irrigation Needs in the main Agricultural Regions of Scotland

by W G Harper

An "Atlas of Long-Term Irrigation Needs for England and Wales" was prepared by Hogg[1], from soil moisture balance sheets based on MAFF Technical Bulletin No. 16[2]. Some of these data have been extended to the main agricultural areas of Scotland in this paper, using climatological records from 43 stations. The assessments are for the growing season April to September.

2. There are some differences in the data and technique employed:-

(a) The basic period of the Scottish material was the 20 years 1954-73. A few stations with shorter periods of record or non-standard periods were included in order to improve coverage. Hogg used records for the period 1930-49.

(b) Soil moisture deficits were calculated at monthly intervals for Scotland. Hogg used half-monthly intervals for England and Wales. The use of the longer time interval tends to underestimate the irrigation requirement. This is compensated to some extent by partial crop cover early in the growing season when transpiration will normally be less than for the full crop cover which has been assumed throughout.

(c) In some years soil moisture deficits begin to build up in March or even earlier. These deficits have been taken into account in the Scottish data. Hogg assumed zero soil moisture deficit on 1 April in every year.

(d) We have assumed that a soil moisture deficit less than 1 inch will not retard growth and that irrigation is applied in whole inches of water. For example, if it is calculated that a deficit of 1.5 in. has built up by the end of the month it is assumed that 1 in. of water will have been applied to the crop during the month. The remaining deficit may be removed by subsequent excess rain or may build up to 1 in. in which case a further inch of water will be applied by irrigation. This is almost identical with Hogg's "Plan 1".

3. Figure 1 gives the total irrigation need in 20 years and corresponds to Hogg's map A57. The largest requirements for irrigation are found on the southern coastal belts of the Moray Firth (Nairn 116 in., Inverness 113 in., Kinloss 109 in.), and of the Firth of Forth (Dunbar 135 in., Haddington 107 in.). The value of 115 in. derived for Arbroath on the coast of Angus seems a little high compared to the 99 in. calculated for Leuchars 30 km further south where the long-term averages of rainfall and sunshine are almost identical. A belt through the Central Lowlands to Kilmarnock in Ayrshire has a total irrigation need of 60-70 inches.

4. The two lowest total irrigation needs calculated were for Eskdalemuir Dumfriesshire (9 in. in 20 years, annual rainfall 62 in.) and Helensburgh Dunbartonshire (16 in. in 20 years, annual rainfall 58 in.). The 10 in. isopleth in figure 1 is based on these figures and on the general trend of annual rainfall in these high rainfall areas.

5. To test the agreement with Hogg's values for total irrigation need in the region of the English-Scottish Border values for Berwick-on-Tweed were calculated for 1954-73 using the method of this paper. The calculated value of 111 in. agrees quite well with the figure of about 105 in. obtained by Hogg for 1930-49. There was no difficulty in matching the isopleths across the Border.

6. Figure 2 gives the irrigation need in the driest year in the 20 years (cf. Hogg map C57). Despite the very dry years 1971-73, the driest year, almost without exception, was 1955.

7. Conclusions

Only a very limited area of Scotland, entirely on the East Coast and mainly on the southern coastal strips of the Moray Firth and the Firth of Forth, has a total irrigation need in 20 years in excess of 100 inches, and a need in the driest year in the range 10 to 13 inches. In comparison the whole of Lincolnshire, East Midlands, East Anglia and Southern England (except Devonshire and Cornwall) has this requirement (Hogg[1]).

References

1. Hogg W H "Atlas of Long-Term Irrigation Needs for England and Wales", Ministry of Agriculture, Fisheries and Food, 1967.

2. "Potential Transpiration", Technical Bulletin No. 16, Ministry of Agriculture, Fisheries and Food, 1967.

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FIGURE 1

TOTAL IRRIGATION NEED IN TWENTY YEARS

PLAN - SMD 1"

APRIL–SEPTEMBER INCHES

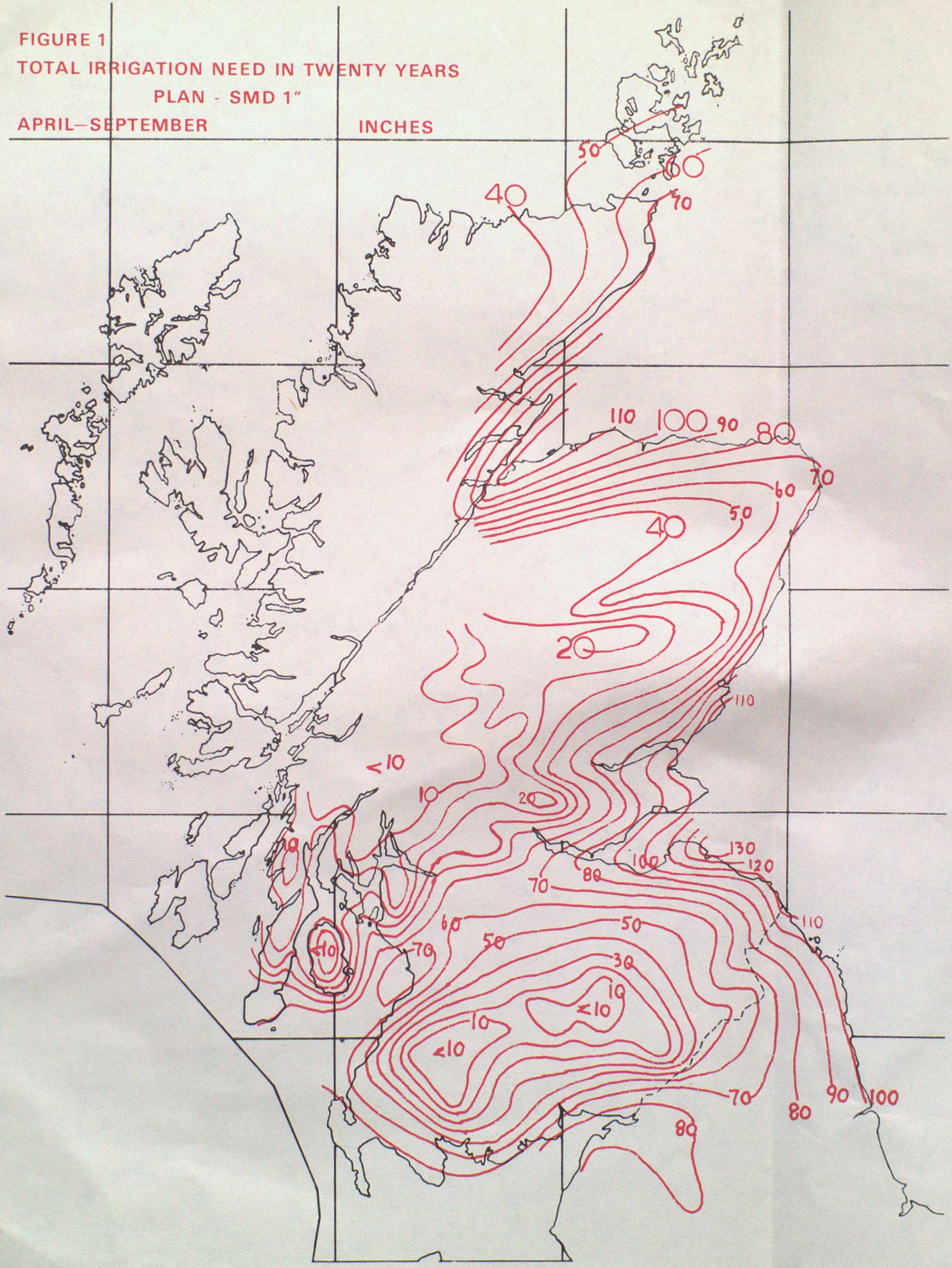

FIGURE 2

IRRIGATION NEED IN DRIEST YEAR

PLAN - SMD 1"

APRIL - SEPTEMBER INCHES